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Method for Analyzing the Interference and Coverage Situation in UMTS Subnetworks

The invention relates to a method for analyzing the interference and coverage situation in UMTS (Universal Mobile Telecommunication System) subnetworks.

UMTS networks are based on ATM (Asynchronous Transfer Mode) and IP (Internet Protocol) and permit the transmission of circuit and packet oriented services. This is made possible by a new air interface for mobile radio communication, which can transmit different formats efficiently. In Europe and Japan, the air interface is based on the WCDMA (Wideband Code Division Multiple Access) radio technology. This permits the migration of a GSM infrastructure into an UMTS network. With WCDMA, Europe, as the worldwide most important mobile radio communication market, is receiving a unified UMTS standard. This also permits mobile broadband communication with Japan. The PDC (Personal Digital Cellular) standard used there can easily be integrated into WCDMA. In America, on the other hand, only a few GSM networks exist. The majority of networks are based on cdmaOne or IS95. These networks are migrating in the third mobile radio communication generation to CDMA 2000 (Code Division Multiple Access) and are compatible with WCDMA. The WCDMA modulation method is no longer based on time slots (Time Division) and the frequency is used "wide" (wideband). At 5 MHz, the transmission frequencies are 25 times wider than with GSM at only 200 kHz. These propagation properties affect both the cell capacity, and accordingly the network planning, as well as the reception quality. During times of low demand by one user, another user can use the channels. A user can also call on multiple data flows, e.g., talk on the telephone, fax, call up e-mails, download a file from the network and surf, at the same time.

From experience with IS95 CDMA networks and initial studies in WCDMA networks, it appears very important that an optimization of the radio signal coverage be performed under incorporation of measurement data. For this purpose the UMTS network is first measured and the existing interference and coverage situation is determined. The method described below is used to determine both, with only data from pilot channel measurements serving as the basis.
Interference matrices form the basis for the interference analysis. As a result of the pilot channel measurements, the received pilot channel power of multiple base stations is obtained for each measuring point. This opens up the possibility of preparing a measurement-data based interference matrix. In the process, the serving base station, as well as the interfering base stations are identified within a locally defined area (=pixel). If this is done across the entire measured area, a statement is obtained for all base stations in this area as to how much they interfere with other cells. This document describes how the interference matrix is prepared, and two different contents of the interference matrix are introduced.

Document WO 01 45284 A1 reveals a method whereby the performance of a CDMA network [is]* calculated by means of simulation. In order to perform the simulation, corresponding input parameters are needed. To determine the performance, best server, traffic load, power, and interference are named here, for example. The strength of the pilot channel and the interference are simulated at each location of the network.

DE 43 02 228 A1 describes a method for allocating frequencies to base stations of a mobile radio network. This requires input information that originates from other simulations. This method is additionally designed for allocating frequencies in a GSM network. The method uses interference probabilities that are presented in matrix form. In contrast to a GSM network, a CDMA network represents an interference-operated network, i.e., all stations transmit on the same frequency.

* Translator's note: Word added by the translator.

The invention has as its object to present a method for analyzing the interference situation and coverage situation in UMTS subnetworks, on the basis of which areas can be determined that are not covered, and the reason for their lack of coverage. It is also a goal to be able to determine which service is available at what location.

This object is met according to the invention with the teaching of the independent claims.

Advantageous designs and improvements of the invention are specified in the dependent claims. The invention permits an examination of the interference and coverage situation for the most varied types of services while taking into consideration the traffic load, and the deduction of the measurement data back to the base without traffic load.

What is claimed is

1. A method for analyzing the interference and coverage situation in UMTS subnetworks, comprising the steps:
   acquiring measurement data within specified area elements of a defined area, wherein, in each area element, the received signal power of at least one downlink pilot channel of multiple base stations that can be received in this area element, and the total background noise power in the analyzed frequency band are measured, characterized by
   preparing an interference matrix based on the acquired measurement data, wherein the interference matrix reflects a statement regarding the interference relationship of each base station with other base stations, wherein base stations that are necessary for a Soft Handover, SHO, are not rated as interferers.

2. A method according to claim 1, characterized in that for the analysis of the interference situation and radio coverage, a statement regarding the radio coverage in the uplink and downlink is determined on the basis of the acquired measurement data under specification of an assumed traffic load of the network.

3. A method according to claim 2, characterized in that the measurement data are acquired while the network is idle, i.e., without traffic load.

4. A method according to claim 2, characterized in that, in each area element, the received signal power of the continuously transmitting pilot channels of multiple base stations that can be received in this area element is identified within each area element, and a statement regarding

the radio coverage in the uplink and downlink is determined by forming the ratio of the received signal power from the analyzed cell (I_{eig}) and the received signal powers from all other cells (I_{fr}).

5. A method according to claim 4, characterized in that the measurement data are acquired during operation, i.e., during regular traffic load of the network.

6. A method according to any of claims 2 through 5, characterized in that the radio coverage is determined separately for each available service.

7. A method according to any of claims 2 through 6, characterized in that a service-specific effective data rate (R) is used as a criterion for determining the radio coverage.

8. A method according to any of claims 2 through 7, characterized in that a service-specific desired value for the signal-to-noise ratio $(E_b/N_o)_{soll}$ is used as a criterion for determining the radio coverage.

9. A method for analyzing the interference and radio coverage in UMTS subnetworks, comprising the steps:
acquiring measurement data within specified area elements of a defined area, wherein, in each area element, the received signal power of at least one downlink pilot channel of multiple base stations that can be received in this area element, and the total background noise power in the analyzed frequency band are measured, characterized by
determining a statement regarding the coverage situation in the uplink and downlink based on the acquired measurement data under specification of an assumed traffic load of the network, wherein the measurement data are acquired while the network is idle, i.e., without traffic load.

10. A method according to claim 9, characterized in that within each area element, the received signal power of the continuously transmitting pilot channels of multiple base stations that can be received in this area element is identified and based on the measurement data a statement is determined regarding the radio coverage in the uplink and downlink by forming the ratio of the received signal power from the analyzed cell (I_{eig}) and the received signal powers from all other cells (I_{fr}).

11. A method according to claim 10, characterized in that the measurement data are acquired during operation, i.e., during regular traffic load of the network.

12. A method according to any of claims 9 through 11, characterized in that the radio coverage is determined separately for each available service.

13. A method according to any of claims 9 through 12, characterized in that a service-specific effective data rate (R) is used as a criterion for determining the radio coverage.

14. A method according to any of claims 9 through 13, characterized in that a service-specific desired value for the signal-to-noise ratio $(E_b/N_o)_{soll}$ is used as a criterion for determining the radio coverage.